APPENDIX A: ABNORMAL EVENT ANALYSIS

Crossflow Test Fire Facility Consequence Analysis

An accident consequence analysis was performed to determine the worst-case impact of an unplanned explosive event as part of a safety analysis to support a weapon surveillance test at the Aerial Cable Test Facility involving test articles that contain potentially hazardous materials.[1,2] The analyzed test article bounds the amount of hazardous materials that will be contained within test units that will be evaluated in the planned Test Capabilities Revitalization (TCR) test facilities, including the Crossflow Test Facility (XTF). The numerical model used to generate a conservative estimate of small fragment production for the materials and system of interest relies on the Grady-Kipp dynamic fragmentation model implemented in the CTH hydrocode. This model has been validated through extensive controlled and full-scale testing.[3]

As noted in a written statement by LLNL, the test environments evaluated in this analysis are "extremely unlikely" to initiate an event that could scatter the materials of concern. Further, the SWEIS estimates the probability of detonation (caused by impacts) to be in the range from 10E-5 to 10E-7, depending on the impact velocity.[4] Nevertheless, the CTH analysis considered the worst-case sequence of events that could theoretically generate the maximum amount of hazardous materials for dispersal. A safety factor was then added to the numerical results to generate a dispersal source term with 40 g each of beryllium, lithium, and depleted uranium. The ERAD/ACRID code developed for the Nuclear Emergency Search Team (NEST) was applied to these source terms for dispersal modeling to determine the maximum potential exposure of on-site workers and the nearest possible offsite residents through (1) the inhalation pathway immediately following release, and (2) soil pathways including incidental ingestion of soil, inhalation of resuspended soil dust for years after the release, and dermal contact.

The criteria used to evaluate the human health risks for each receptor (on site workers and off site residents) were as follows:

<u>Air inhalation</u>: modeled air concentrations were compared to the DOE beryllium action level of 0.2 µg/m3 (10 CFR 850), which corresponds to 0.096 mg-min/m^3 for onsite workers. The screening benchmark used for chronic residential air exposure to beryllium was 0.008 µg/m3, which corresponds to 0.004 mg-min/m^3. Similarly, the screening level for lithium is 0.25 µg/m^3, which corresponds to 0.120 mg-min/m^3.

<u>Soil Ingestion/Inhalation</u>: The NMED screening level for beryllium in soil is 440 mg/kg for industrial receptors and 150 mg/kg for residential receptors.

The modeling considered dispersal under both stable and unstable meteorological conditions. The stable environment creates the most adverse scenario from a health risk standpoint. Figure 1 illustrates the maximum ground level concentrations of beryllium that would be achieved within an 8-hour period under stable and unstable meteorological conditions following a hypothetical worst-case uncontained explosive event. As shown in the figure, the occupational exposure limit threshold concentration levels for beryllium would not be generated at any location during the 8-hour period following an explosion, regardless of the meteorological conditions. This also applies to the lithium, which would disperse in the same manner as the beryllium. Since the beryllium concentration action levels are lower than the lithium action levels, the Figure 1 beryllium dispersal results bound lithium dispersal concentrations.

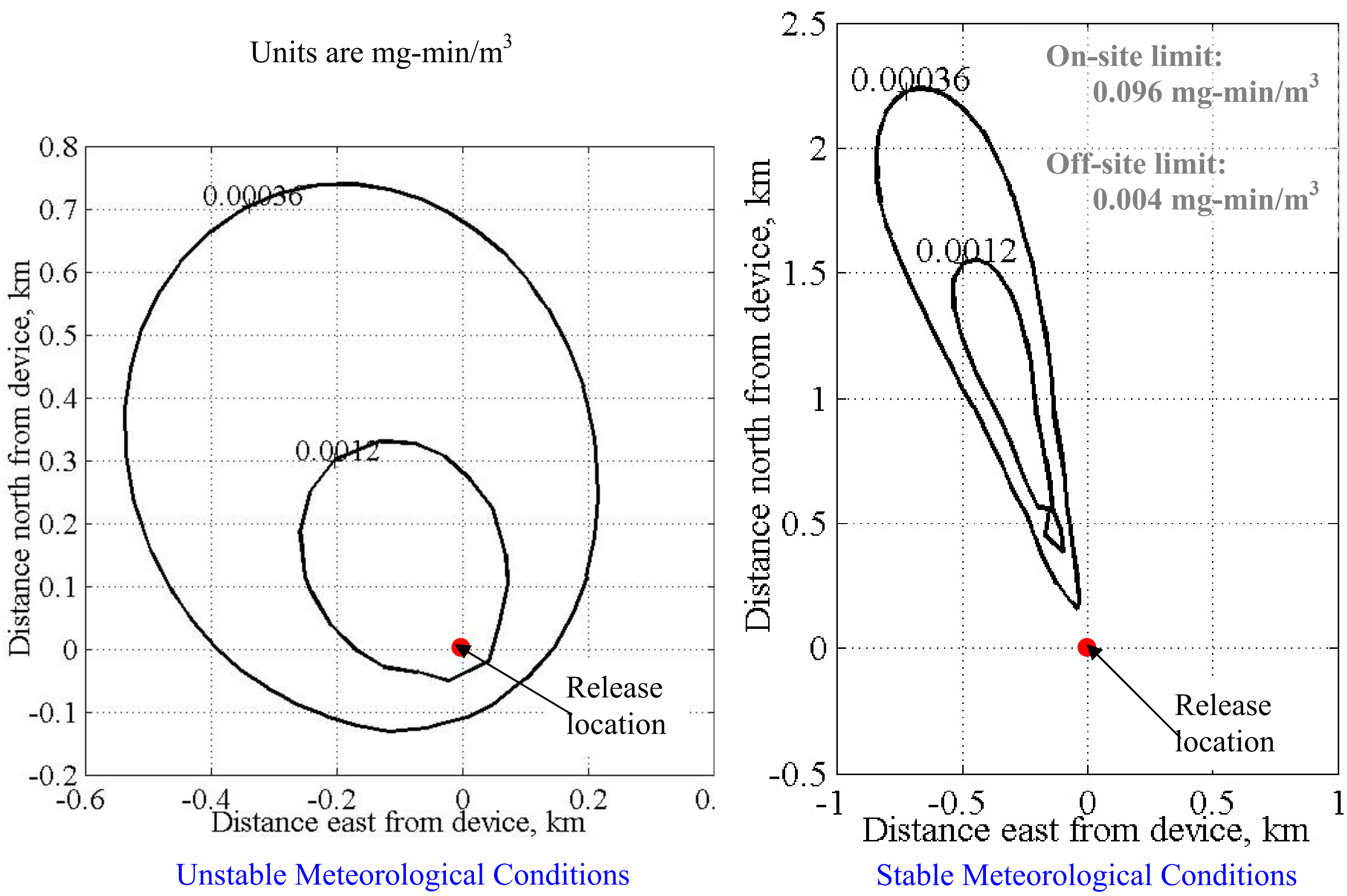

Figure 1. ***Maximum beryllium concentration levels established in 8-hr period for dispersal in unstable (left) and stable (right) meteorology. Be results envelope Li concentrations.***

Figure 2 presents the computed soil deposition levels. As shown in the figure, the deposited quantities are orders of magnitude below the regulatory thresholds. Further, since the maximum number of test articles containing beryllium, lithium, and depleted uranium to be performed during the life of the facilities is on the order of tens, cumulative depositions from these low probability potential explosive events could not approach the regulatory thresholds.

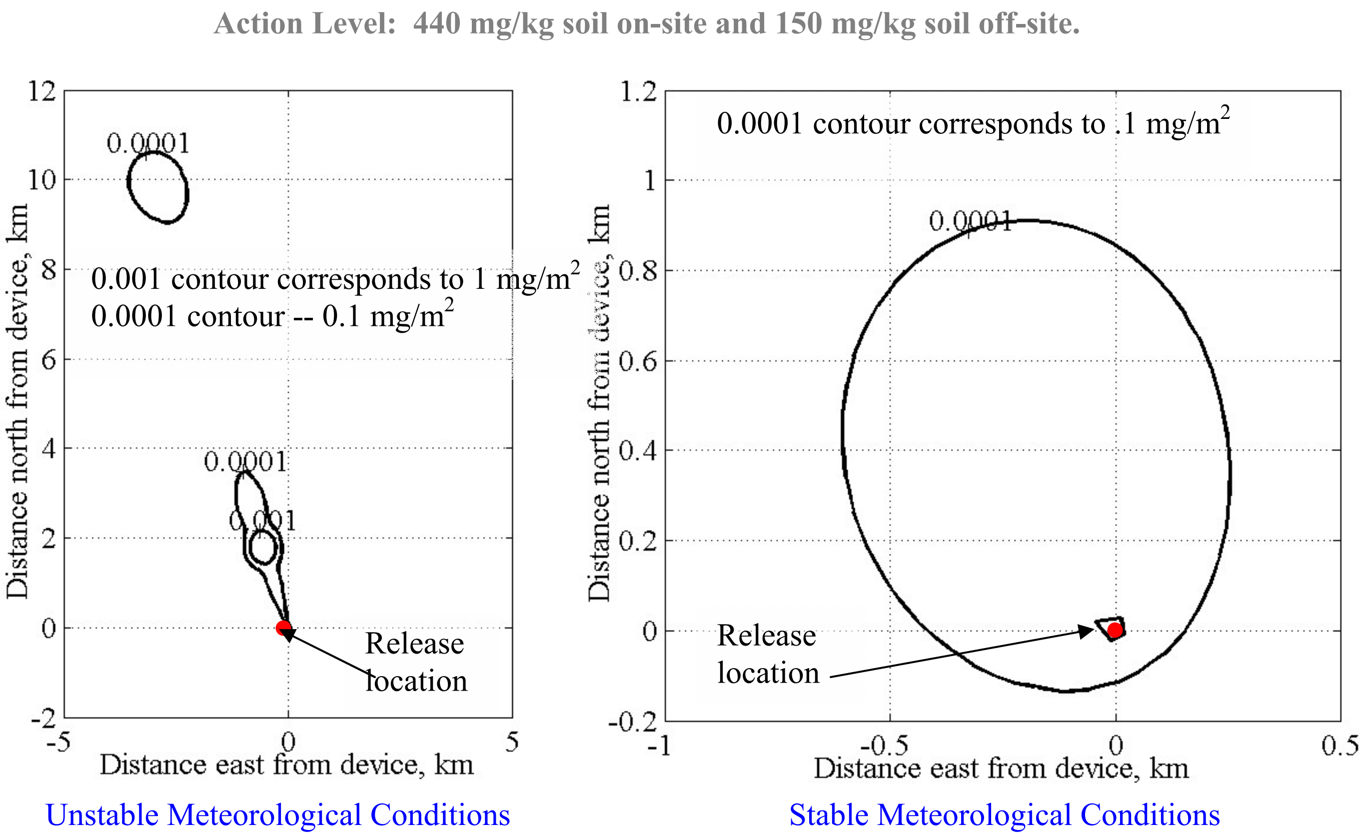

Figure 2. ***Maximum beryllium soil deposition levels. Beryllium results envelope Li deposition quantities.***

Figures 3 and 4 display the worst-case uranium chronic dose and soil deposition quantities that would be generated under both stable and unstable meteorological conditions. As illustrated by the maximum value contours, neither the dose nor deposition magnitudes are large enough to be of concern.

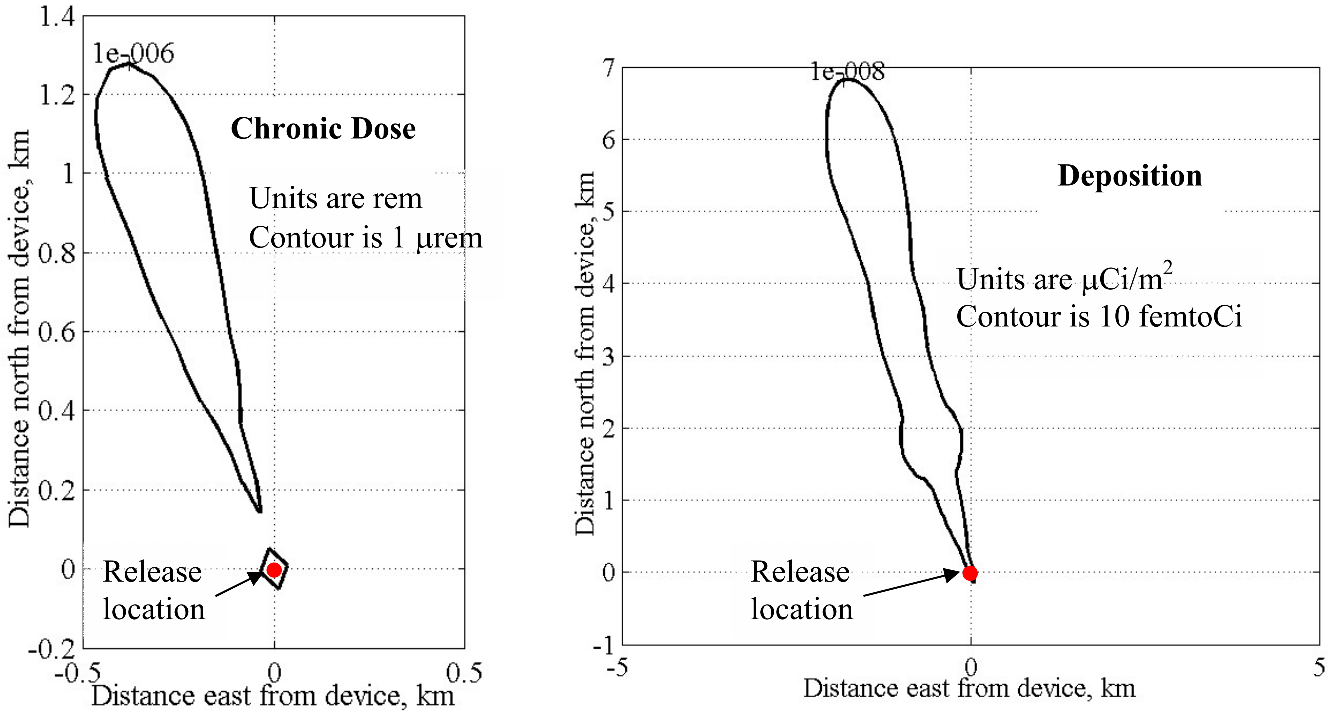

Figure 3. ***Maximum uranium dosage and deposition for stable meteorological conditions.***

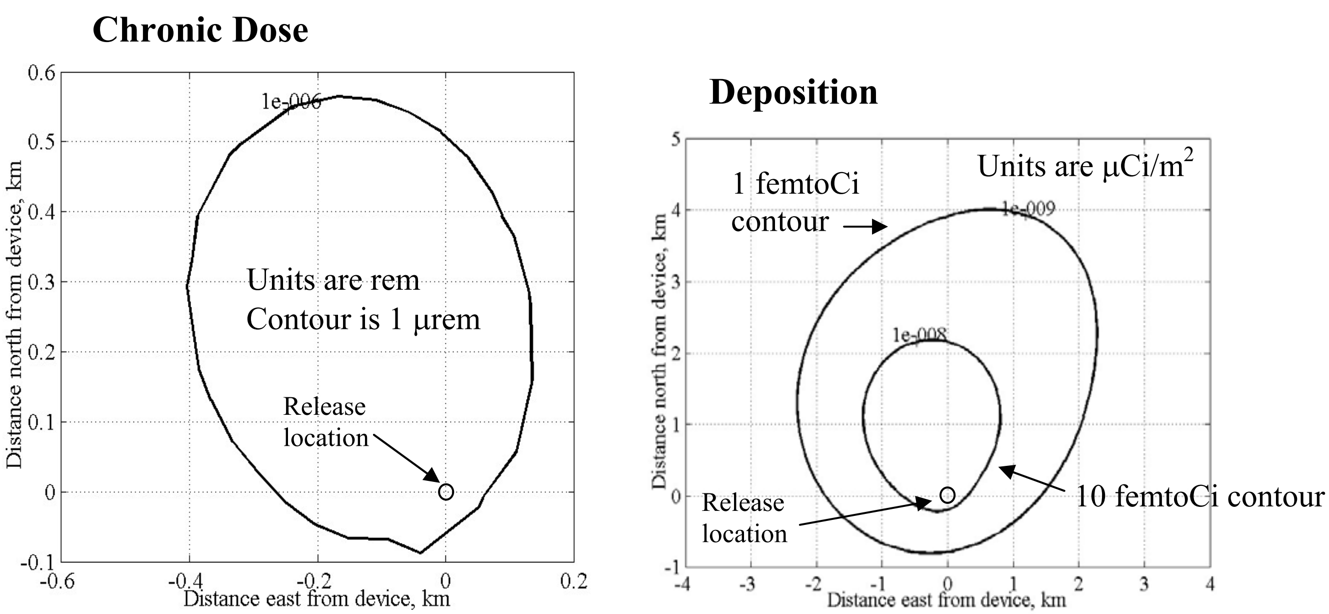

Figure 4. ***Maximum uranium dosage and deposition for unstable meteorological conditions.***

In summary, this consequence analysis demonstrates that a low probability hypothetical blast that includes both air releases and the subsequent deposition of the release onto soils would pose no human health risk. Specifically, the release and dispersal of beryllium, lithium, and depleted uranium would be significantly below the regulatory action levels. Though this analysis was initially conducted for another purpose and site, the results are directly applicable to the XTF and all other TCR test facilities. The source terms for dispersal duplicate the worst-case scenario for the XTF if the building itself is ignored (i.e., the actual amount that would escape the facility would be less than the uncontained open air scenario).

References:

1. L. J. De Chant, SAND2002-1620 (SRD classified report).
2. L. J. De Chant, SAND2003-2778 (SRD classified report).
3. L. J. De Chant, "Validation of a computational implementation of the Grady-Kipp dynamic fragmentation theory for thin metal plate impact using an analytical strain rate model and hydrodynamic analogues", SAND2003-3382J, submitted for publication to Mechanics of Materials, 09-03.
4. U. S. Department of Energy, October 1999, *Sandia National Laboratories/New Mexico Final Site-Wide Environmental Impact Statement*, *Albuquerque, New Mexico*, DOE/EA-0576, U. S. Department of Energy Office of Defense Programs, Washington, D.C.